

**TABLE 3-1, CONTINUED**  
**SIGNIFICANT BIRD MORTALITY EVENTS OVER LAST 50 YEARS**

<b>Location</b>	<b>Type of Tower</b>	<b># of Species / Most Common Species Migratory or Non Migratory</b>	<b>Season, Dates &amp; Duration</b>	<b>Description</b>	<b>Reference</b>
Springfield, Illinois	Television Tower, 998 feet	40 species  Gray checked thrush  Migratory	Fall September 16, 1959	Estimated 1,000 to 1,500 birds of over 40 species in heavy fog and low clouds	Parmalee and Parmalee 1959
Lewisville, Minnesota	Television Tower, 1,116 feet	47 species / Red eyed vireo Migratory	Fall September 20/21, 1963	Documented 924 birds of 47 species	Janssen 1963
Wisconsin and Minnesota	Television Tower (2), ?? feet		Season unknown - nights during migration, 1963	Recovered and identified 9,119 birds between the two sites	Kemper 1964
Michigan	Television Tower (7), 920 to 1,281 feet	92 species	Spring 1962-1964 and Fall 1959-1964	Recorded 6,505 birds of 92 species	Caldwell and Wallace 1966
Allegheny Plateau, New York	Communication Towers, ?? feet	NR	N/A	Estimate of over 10,000 passerines killed per year, based on monitoring of upstate New York communication towers and conservative extrapolations	Eaton 1967

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WECT and WWAY Television Towers, North Carolina	Television Tower (2), 1,994 and 1,188 feet	<ul style="list-style-type: none"> <li>• 88 species / Common Yellowthroat</li> <li>• 65 species / American Redstart</li> </ul> Migratory	Fall migrations 1970, 1971, and 1972 Continued studies 1973-1977	<ul style="list-style-type: none"> <li>• Recorded 3,070 birds, totaling 88 species for all surveys</li> <li>• Recorded more than 4,208 individuals of 65 species, including one night (September 4/5, 1974) in which 3,240 birds were killed.</li> </ul>	Carter and Parnell 1978
WCYB, WJHL, and WKPT Television Towers, Tennessee	Television Tower (2), 125 and 85 feet	NR	Fall September 30, 1972	1,801 bird mortalities reported at two locations on top of Holston Mountain following a cold front with precipitation and low cloud ceiling	Herndon 1973
Omega Tower, North Dakota	Television Tower, 1,200 feet	NR	Spring and fall, 1971-1973	Studies estimated 4,298 birds and documented 5 red bats	Avery et al. 1975, 1977, and 1978
Illinois	Television Tower (7), 605 to 1,587 feet	NR	Fall Between September 2 and November 12, 1972	Collected 5,431 birds at 7 tower sites with 93.4% of the mortalities occurring on 3 nights in September and 1 night in October following cold fronts with reduced visibility and low cloud ceiling	Seets and Bohlen 1977
Orlando, Florida	Television Tower, – 1,484 feet	82 species / Common Yellowthroat  Migratory	Fall monitoring 1969-1971	Documented 7,782 birds of 82 species	Taylor and Anderson 1973

**TABLE 3-1, CONTINUED**  
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Location	Type of Tower	# of Species / Most Common Species Migratory or Non Migratory	Season, Dates & Duration	Description	Reference
Ostrander, Minnesota	Television Tower, 1,314 feet	<ul style="list-style-type: none"> <li>84 species / NR</li> <li>28 species / NR</li> </ul>	<ul style="list-style-type: none"> <li>Sporadic monitoring from 1961 to 1974</li> <li>Fall September 19, 1963</li> </ul>	<ul style="list-style-type: none"> <li>collected 3,507 birds of 84 species</li> <li>estimated minimum of 1,000 to 1,500 birds of 28 species</li> </ul>	Feehan 1963  Strnad 1975
Elmira, New York	Television Tower, 843 feet	NR	<ul style="list-style-type: none"> <li>Fall September 20-24, 1977</li> <li>1966-1977</li> </ul>	<ul style="list-style-type: none"> <li>Collected 3,862 birds of 44 species, with 82% (3,175 kills) occurring on 2 nights.</li> <li>Total estimated mortality over 7,400 birds during the 11-year period.</li> </ul>	Welles 1978 Howard 1977
Tall Timbers Research Station Florida	Television Tower, 669 feet, 1,010 feet, 295 feet	186 species / Red-eyed vireo  Migratory	Spring and fall 1955 to 1983	Beginning in 1955, recorded 15,200 birds over 5.5-year period  44,007 individual birds of 186 species over 29-year period 1955 through 1983. Examined mortality numbers as tower height changed and examined predator/scavenger effects.	Stoddard 1962  Crawford and Engstrom 2001

**TABLE 3-1, CONTINUED**  
**SIGNIFICANT BIRD MORTALITY EVENTS OVER LAST 50 YEARS**

Location	Type of Tower	# of Species / Most Common Species Migratory or Non Migratory	Season, Dates & Duration	Description	Reference
Topeka, Kansas	Television Tower, -1,440 feet	91 species / Gray catbird, sora, orange crowned warbler  Migratory	Fall 1985 to 1994	Four mortality events preceded by cold fronts and low cloud ceilings totaling 2,808 birds of 91 species.  <ul style="list-style-type: none"> <li>▪ September 25/26, 1985, recorded 919 birds of 54 species.</li> <li>▪ September 30/October 1, 1986, recorded 635 birds of 49 species.</li> <li>▪ October 11/12, 1986, recorded 834 birds of 64 species.</li> <li>▪ October 8-9, 1994, recorded 420 birds of 45 species.</li> </ul>	Ball et al. 1995
Kentucky	Television Towers (2), 1,000 and 1,739 feet,	NR	Fall and spring - 1983, 1986, 1990	1,806 (1983 and 1986) and 133 (1990) total bird mortalities, by tower respectively	Elmore and Palmer-Ball 1991
Eau Claire, Wisconsin	Television Tower, 1,000 feet	123 species / Red-eyed vireo, Tennessee warbler, ovenbird	1957 to 1995	Reporting 121,560 birds of 123 species over the 38-year period. One-night record kill occurred in 1963 where over 12,000 birds were collected and identified without adjusting for scavenger rates.	Kemper 1996  Manville 2000a
Nashville, Tennessee	Television Tower, 1,368 feet	112 species / Warblers and vireos	Fall September 1 to October 1, 1960 to 1997	Documenting 19,880 birds of 112 species, with the largest bird kills occurring on September 26, 1968 with 5,399 bird mortalities and on September 28, 1970 with 3,487 bird mortalities	Nehring 2000; Nehring and Bivens 1999

**TABLE 3-1, CONTINUED**  
**SIGNIFICANT BIRD MORTALITY EVENTS OVER LAST 50 YEARS**

<b>Location</b>	<b>Type of Tower</b>	<b># of Species / Most Common Species Migratory or Non Migratory</b>	<b>Season, Dates &amp; Duration</b>	<b>Description</b>	<b>Reference</b>
Western Kansas	Radio Towers (3), 300 to 420 feet	Lapland longspurs	January 22, 1998	Between 5,000 and 10,000 Lapland longspurs killed at three towers and a natural gas pumping station on one foggy, snowy night. The largest bird kill in the Midwestern U.S. to date.	The Wichita Eagle 1998
New York and Ohio	Television towers (3), 961 to 1,084 feet	106 species – New York / Warblers and vireos  80 species – Ohio / Warblers and vireos	1970 to 1999	20,148 bird mortalities (106 species) recorded at the three New York towers; between 1974 and 1992, 4,310 mortalities (80 species) recorded at the one Ohio tower. Assuming these summaries extrapolated from A. R. Clark's surveys from 1967-2000, where he collected 20,514 birds of 110 species.	Morris et al. 2003

NR – Not Recorded

### **3.2.1 Study Duration and Survey Methods**

Study design, study duration, and incidental mortality records have greatly varied over the last 50 years of communication tower reporting. This variance makes it difficult to compare scientifically based study results and more anecdotal mortality reports to adequately understand the extent of avian collisions with communication towers and whether the incremental and cumulative avian mortalities may be biologically meaningful to migratory species.

One of the primary issues identified to date and previously discussed during the August 11, 1999 *Workshop on Avian Mortality at Communication Towers* (Evans and Manville, 2000) is the lack of standardized methods and metrics for analyzing the extent of bird mortalities at communication towers. This topic is discussed in greater detail in Section 4.0.

In reviewing certain aspects of reported tower kills and associated monitoring studies, noting the absence of mortalities may be as important as noting the presence of large numbers of bird mortalities (i.e., “negative evidence may be as important, on occasion, as positive”) (Stoddard 1962). In other words, it is just as important to record those towers of certain height, configuration, lighting regimen, and habitat that have not reported bird mortality. By limiting tower monitoring to only those towers associated with reported collision and bird mortalities may, in fact, prevent further characterization of collision factors and additional information that may be useful in minimizing future collision risk at certain tower sites.

### **3.2.2 Survey Biases**

A few studies and researchers discuss the potential for biases in communication tower surveys. Potential survey biases include: 1) scavenger or predator removal (i.e., carcasses that are removed prior to surveys); 2) search efficiency (i.e., birds that may be missed during area searches); 3) habitat conditions (i.e., wetlands, water bodies and dense vegetation that cannot be searched); and 4) bird crippling (i.e., birds that may be crippled by tower collision but fall outside the search area). Any one of these biases could result in lower estimates of mortality at a tower site.

Predation or removal of bird carcasses by scavengers can significantly affect estimated mortality levels. In some areas of bird kills at communication tower sites, scavenger removal is rapid and aggressive (Kale et al. 1969; Kemper 1996; Crawford 1971; Crawford and Engstrom 2001; Stoddard 1962). Stoddard reported that nocturnal scavenger removal rates were high at his Florida study site, with carcasses often being consumed or removed within 0.5 hour of dawn (Kemper 1996). Carter and Parnell (1976 and 1978) reported notable scavenging of bird carcasses at two North Carolina towers, but no mortality adjustments were calculated. For one mass kill recorded on September 4-5, 1974, Carter and Parnell (1978) estimated that the number lost to predators and in dense vegetation and wetland areas could double the 3,200 birds collected from that one night.

Other representative data that examine predator or scavenger effects include the data summaries from the WCTV Television Tower, Florida, Tall Timbers Research Station, 29-year tower study. Crawford and Engstrom (2001) calculated the mean number of individuals killed was 2,248 ( $\pm 950$ ) for years when scavenger controls were applied, and the mean number of mortalities was 642 ( $\pm 362$ ) for years with no scavenger controls. Records also show that even with predator controls in effect, Stoddard was reporting an approximate 10% loss to scavengers (Crawford and Engstrom 2001).

Some studies have exhibited low scavenging rates. Avery et al. (1975 and 1978) monitored the scavenger removal rate of planted birds during both the spring and fall migratory periods in 1972 and 1973. Based on the low scavenging rates recorded, it was assumed that the daily carcass searches at the tower site kept the losses to scavengers and predators to a low level, and no mortality estimate adjustments were applied. However, based on the high scavenging rates recorded for some studies (Crawford 1971; Crawford and Engstrom 2001), predator control measures may be warranted for some areas (Crawford 1971), although not feasible for all studies. At a minimum, by estimating the scavenger removal rate of that site, the mortality numbers could be adjusted accordingly.

Although very few avian studies at communication tower sites incorporate scavenger removal studies, these estimates during both the spring and fall migration periods can aid

in determining the overall scavenger rate for an area. This rate adjusts the mortality estimate accordingly, to provide a more representative number of bird kills. Without incorporating scavenger removal rates, relatively small kills (10 to 50 birds) could be masked by scavengers (Crawford and Engstrom 2001) and mortality numbers may be under-represented.

Surveyor bias relates to search efficiency, associated search images, and the potential for birds to be missed during tower surveys. Carter and Parnell (1978) provide a good example of the effects to mortality estimates from surveyor bias. The mass kill that occurred at a North Carolina tower (September 4-5, 1974) resulted in 3,200 birds retrieved, and estimated that thousands more were not found because of dense vegetation and loss to scavengers and predators. An area searched by two individuals was subsequently re-examined by a third surveyor. An additional 500 birds were discovered during this third attempt. As stated previously, without adjusting for search efficiency, the mortality estimates recorded at a particular tower site may be under-represented.

Other biases, such as habitat conditions and crippling effects, likely affect most tower studies to some degree and were indirectly mentioned in some reports. However, only general references were made to these effects (Carter and Parnell, 1978). Recommendations for addressing study biases are discussed further in Section 4.1.4.

### **3.2.3 Mass Mortalities vs. "Trickle Kills"**

As might be expected, a significant amount of attention is drawn to records of mass bird kills at communication tower sites over the last 50 years. The following incidental reports of thousands of birds killed in one night are representative of these mass kills. The following list coincides with some of the mortality reports listed in Table 3-1 and are repeated here to better characterize the historical focus on single night, mass kills. These kills receive the greatest scrutiny from the media, public, and regulatory agencies; are often the focus of opposition to tower siting; and may have the greatest potential to result in regulatory action.

- 2,500 birds at a North Carolina tower on September 28, 1956 (Trott 1957).

- 1,000 to 1,500 birds at an Illinois tower on September 16, 1959 (Parmalee and Parmalee 1959).
- At a central Florida tower (Taylor and Anderson 1973):
  - 1,592 birds on September 29, 1970.
  - 859 birds on September 30, 1970.
- 1,801+ birds at four Tennessee towers at two locations on Holston Mountain on September 30, 1972 (Herndon 1973).
- At seven Illinois towers (Seets and Bohlen 1977):
  - 221, 735, 110, and 266 birds at four towers on September 2, 1972.
  - 391, 807, 992, 127, 634, and 206 birds at six towers on September 27, 1972.
  - 107 and 319 birds killed at two towers on September 29, 1972.
- At a New York tower (Welles 1978; Howard 1977):
  - 844 birds on September 22, 1974.
  - 1,817 birds on September 20, 1877.
- 3,240 birds at North Carolina tower on September 5, 1974 (Carter and Parnell 1978).
- At the Tall Timbers Research Station, Florida tower (Stoddard 1962 and Crawford 1978) (Note: a number of kills greater than 100 birds in a night were reported for this tower over the 29-year study. The following summaries include representative records over 400 birds in one night):
  - 4,000 to 7,000 birds on October 9, 1955.
  - 2,325 birds on October 5, 1957.
  - 971 birds on October 17, 1974.
  - 636 birds on September 14, 1975.
  - 486 birds on September 15, 1975.
- At a Kansas tower (Ball et al. 1995):
  - 919 birds on September 26, 1985.
  - 635 birds on October 1, 1986.
  - 834 birds on October 12, 1986.
  - 420 birds on October 9, 1994.
- 12,000 birds at a Wisconsin tower on 1 night in 1963 (Manville 2000a).
- At a Tennessee tower (Nehring 2000; Nehring and Bivens 1999):
  - 5,399 birds on September 26, 1968.
  - 3,487 birds on September 28, 1970.

- 5,000 to 10,000 birds at a Kansas tower facility on January 22, 1998 (The Wichita Eagle 1998).
- +1,576 and 133 bird mortalities at two Kentucky towers respectively (Elmore and Palmer-Ball 1991).

“Trickle kills” is a term used for the incremental mortality reports of low numbers of birds at tower sites, as compared to the mass kills that are more prominent in the literature and popular press. In the absence of routine surveillance of telecommunication towers, the extent of ‘trickle kills’ is poorly understood. Moreover, the potential cumulative effects of “trickle kills” remain an issue.

### **3.2.4 Declining Mortality**

An observation that may have far-reaching repercussions for the communications industry is, that over the last five decades of monitoring bird populations, the number of bird mortalities at towers is reported to be decreasing while the number of towers is increasing. All long-term studies show a similar decline in total bird mortality (with other factors remaining equal, e.g., tower height).

Morris et al. (2003) compared mortality data from 1970 to 1999 for four separate towers (three in New York and one in Ohio), which were all approximately 1,000 feet in height. This comparison reported a “significant decrease” in the number of birds salvaged at all four towers occurred within the 30-year period, suggesting a corresponding reduction in the number of birds that collided with the towers during the same period. Morris et al. (2003) speculates on several possibilities to explain this reduction in bird mortality and include:

- Overall decrease in the migratory populations.
- Potential change in patterns of wind direction, cloud cover, and visibility.
- An increase in predator and scavenger removal of bird carcasses at tower sites.
- A change in the migration patterns.

- An increase in background light pollution (therefore a decrease in migrant attraction to tower lighting).
- An evolutionary reduction in bird attraction to tower lights.

However, when comparing the similar and parallel reduction in number of bird mortalities at the four tower sites, Morris et al. (2003) further suggest that the factors affecting changes in detected migrant mortality at communication towers are more likely large-scale factors, such as weather patterns and population size, rather than more site-specific factors, such as an increase in scavengers.

Nehring and Bivens (1999) reviewed a 38-year mortality study at a 1,364-foot television tower in Tennessee. They report a similar reduction in the number of mortality rates and species' diversity over time. Even after deducting the two mass kills recorded in 1968 and 1970, the long-term trend showed a significant reduction in the number of birds killed. They speculate on three potential causes for this decline, including:

- A change in the migration routes to avoid the expansion of Nashville, Tennessee.
- An increase in background light pollution, thereby reducing the attraction to the tower lights.
- An increase in scavenging rates, resulting in a decrease in birds recovered which is not indicative of a true measure of mortality.

Discussions on the reduction in bird mortality due to tower collisions over the last five decades have been speculative and have not been technically substantiated. Additional research on the hypotheses advanced is needed.

### **3.3 NOTICE OF INQUIRY COMMENT REVIEW AND SPECIFIC FACTORS AFFECTING BIRD COLLISIONS**

The FCC's NOI (August 20, 2003) requested specific comments on a number of issues associated with avian collisions with communication towers including the current state of scientific information regarding the magnitude of these collisions and the effects of tower lighting, tower height, type of antenna structure, location of antenna structure, and other factors. In addition, information was solicited regarding the need for and scope of

additional studies and suggested methods to minimize impacts. Within each of these categories, FCC posed a number of biologically based questions for comment.

In evaluating the information provided by respondents to the NOI, the FCC requested review of 12 specific comments and reply comments. These comments and the approach to their review have been previously discussed in Section 2.0 of this report (Table 2-1).

One of the principal objectives for this report includes a review and evaluation of the available, technically supportable information regarding the role that specific factors may increase or decrease the incidence of avian collisions with communication towers. The NOI comments and cited studies discuss a number of factors that may affect the incidence of avian collisions with telecommunications towers including:

- Migration patterns and seasonality
- Bird behavior
- Tower height and configuration
- Tower siting
- Tower lighting
- Weather

For each of these factors, the following subsections present a general discussion of the factor, e.g., bird behavior, followed by a discussion of the information provided in specific studies cited in the NOI comments. In addition, a discussion of the current research into the affect these factors may have on avian collisions is discussed where relevant.

For each of the associated topics and biologically based questions presented in the NOI, substantive comments on those topics were gleaned from each of the comments. Basic assumptions, conclusions, and opinions are further supported by the avian studies and incidental reporting. In the specific commenter response section, only those comments that contained a reference to that specific issue or topic are included; therefore, if a letter

is not mentioned for a topic, the reader can assume the respondent did not address that issue in response to the NOI requests.

The numbers (e.g., 14, 15) refer to the paragraph numbers (where applicable) listed in the NOI. Some topics discussed (e.g., weather, bird behavior) were not specifically identified in the NOI; however, these subjects have been included and addressed since they are integrally involved in research of avian collisions with communication towers.

By way of background to the following discussion, a common theme that was observed in the NOI responses involved differing and/or the lack of definitions of terms. In particular, when a respondent debated the magnitude and importance of the mortality associated with tower strikes, the term “significance” was frequently used without defining the context of its use. For example, a number of respondents stated that mortality caused by telecommunication towers was biologically “insignificant” without qualifying the term. The term “biological significance” has been used to express a variety of meanings. Among others, it is used to reference individual, population and community level effects, species afforded special protection (e.g., endangered species or migratory species), or in reference to other regulatory legislation (e.g., the National Environmental Policy Act). Because of these different contexts and definitions of “biological significance,” caution must be taken in interpreting its meaning. A discussion of “Biological Significance” is presented in Section 3.5.

### **3.3.1 Current State of Scientific Information**

The following discussion is associated with the request by FCC in its NOI to provide specific information regarding the quantity and quality of existing data documenting the mortality of migratory birds due to collisions with communication towers.

As defined by Department of Interior (See Federal Register, Friday, October 12 2001.<sup>50</sup> CFR Part 10 General Provisions: Revised List of Migratory Birds: Proposed Rule) migratory birds include several hundred species of waterfowl, shorebirds, songbirds, raptors and other groups.

### **3.3.1.1 NOI Questions**

- *14. We seek comment on and analysis of existing scientific research and studies relating to the impact that communications towers may have on migratory birds.*
- *We ask that comments thoroughly discuss the methods that are used to quantify any information provided on this matter.*
- *We seek comment on the extent of migratory bird deaths that may be attributable to collisions with communications towers, the species and geographic locations involved, and what the raw numbers mean in terms of survival of species or in other relevant contexts.*
- *15. We also seek comment on the adequacy and reliability of scientific research on the impact of towers on migratory birds, including whether the parties that conducted the research are considered to be experts in the field and whether the research was conducted in a scientifically acceptable and rigorous manner.*
- *We seek comment on the extent to which research has considered these or other variables, and whether the research has considered the appropriate combination of variables in order to achieve reliable results.*
- *16. We also seek comment on whether the research included effective protocols to account for the actual numbers of birds killed at specific towers.*

### **3.3.1.2 General Responses and Summaries**

Overall, there is general agreement that there is sufficient documented evidence of avian mortality by communication towers and that the construction and operation of tall structures will likely result in the risk of bird collisions and possible mortalities. This possibility is an unavoidable consequence of any elevated structure in the flight path of migrating birds. However, not all towers present the same collision hazard, and the same tower may result in markedly different mortality rates from night to night or season to season. The structure type, height, siting, lighting, season, species present, and weather conditions are thought to affect the potential risk for avian collisions and the magnitude of these effects. For the most part, comments of the NOI respondents do not disagree with this statement.

Although not all towers present the same collision risk, there is a consensus among the respondents that more information is needed to specifically identify the associated factors

and the degree that each factor contributes to avian collision risks at communication tower sites.

Documented studies and anecdotal information were received referencing mortality to migratory birds. Both infrequent mass bird kills (e.g., scores to hundreds of birds) and smaller “trickle” kills were discussed by several respondents including industry (e.g., CITA et al.), government (USFWS), and environmental organizations (e.g., American Bird Conservancy, Forest Conservation Council, and Friends of the Earth). The American Bird Conservancy provides a species compilation through 2000 (Shire et al. 2000) of more than 230 bird species that have been documented at communication tower sites. Almost all of the reported mortality is associated with small songbirds although some gulls, waterfowl, shorebirds, and waders are occasionally recorded. Ninety-two percent of the mortalities are migratory species with the majority being nocturnal migrants.

NOI respondents did not explicitly address raw mortality numbers and species’ survival rates. See Section 3.3.10 for additional discussions regarding avian mortality patterns. The term “significant” was used by many respondents, but each used the term differently. See Section 3.5 regarding “biological significance” and the difficulties in defining and applying this term.

No recent research was provided to account for the actual numbers of birds killed at communication towers (see Section 3.3.10). Past studies were referenced as an estimation of the amount of mortality at communication towers. Some, but not all, of these older studies attempted to account for scavenger removal rates and observer bias. Because of this inconsistency, cross-study comparisons are limited. Nor was any recent research provided on other variables.

Without a collective effort to record bird mortality it is difficult to predict the true magnitude of the problem. That birds are colliding with towers has been well-documented (See Section 3.2). USFWS (Manville 2001b), Evans (1998), and Woodlot (2003) have arrived at estimates of avian collisions with communication towers ranging

from 2 to 5 million birds per year. Although the etiology of bird-tower mortality is a current research need, the empirical data and anecdotal reports on avian collisions with communication towers have contributed valuable information toward answering some of these questions and establishing a framework for developing standard methods and metrics necessary for comparing study results.

The lack of standardized methods for bird mortality surveys at tower sites suggests that avian mortality is likely underestimated for that particular sampling period or reported incident. Because of the lack of sufficient studies, it is not possible to draw conclusions on geographical mortality patterns. In addition, most mortality studies are from the eastern portion of the U.S., limiting our knowledge on other areas of the country.

Section 3.2 provides an overview of past, present, and proposed studies and incidental mortality reports at communication tower sites in the U.S. Section 4.1 discusses data gaps and lack of consistent methodology, with specific recommendations for future actions, based on the literature and best professional judgment. Additional dialog and planning is warranted, given the number of unknowns and inconsistencies among stakeholders.

### **3.3.1.3 *Specific Respondent Comments***

The following discussion provides a summary of the respondent's comments regarding the current level of scientific information pertaining to avian collisions with communication towers.

PCIA is a trade association representing the wireless telecommunications and broadcast infrastructure industry. PCIA members own or manage approximately 50,000 towers. PCIA conducted a survey of its members requesting information on bird collision mortality and its relationship to tower height, configuration, lighting, seasons, weather, and time of day. PCIA reported that it had received a 74% response rate from its membership. This response rate was based on responses from an unspecified number of representatives owning or managing 37,000 towers. Unfortunately, a compilation of the survey data was not provided.

The first question in the PCIA survey requested information on bird collisions. Survey Question 1 asked: "In your experience, is there evidence to suggest that birds – migratory or other – are colliding with the towers you oversee? For example, do the equipment compounds have signs of bird kills that could have been caused by such a collision?" According to the PCIA survey results, responding members overwhelmingly indicated that they do not observe or find evidence of bird collisions around towers. One respondent stated that evidence of bird collisions is found at 0.5% of tower sites it managed. Unfortunately, it is not clear how many tower sites these collective data represent or how these results were derived. PCIA also stated the survey respondents did not report any incidences of "significant" bird kills. There are no questions in their attached survey request on "significant" events, so presumably this was provided as supplemental information. Additionally PCIA does not define "significant bird kill" or "significant event." Although the survey is a good attempt at obtaining the industries knowledge on bird collisions, no new defensible evidence was provided on avian mortality or the role of specific factors affecting bird collisions. Absent the raw data, it is not possible to draw any defensible conclusions from the survey results, as reported in the PCIA comment letter.

CTIA and NAB stated that "reports claiming communications towers have been responsible for significant bird kills" are isolated and anecdotal. They also stated "no reliable scientific basis exists for accurately estimating the numbers of migratory birds killed by collisions with communications towers."

Woodlot (2003) reviewed existing literature for CTIA, PCIA, and NAB. Woodlot provided an overview of these studies and grouped this literature into non-peer reviewed and peer-reviewed literature. In reviewing the literature and extrapolating various area-specific studies, Woodlot acknowledged that comparisons between various mortality types should be made cautiously due to the limitations of this approach. Specifically, mortalities from windows and buildings, vehicle collisions, wind turbines, transmission lines, pesticides and oil pollution, cat predation, hunting, and communication towers were evaluated. An estimated range of 381 million to 2.3 billion birds dies each year from

human-caused factors. Of these, collisions with communication towers represent approximately 0.05 percent (5 million birds) of the annual migratory bird population. It is uncertain what impact these sources of mortality are having on bird populations. Woodlot further commented that some experts believe the estimate of 4 to 5 million birds per year could be off by an order of magnitude. This statement was not clarified.

The USFWS presented a thorough history of bird collisions, while acknowledging that much is simply still not known about the impacts of communication towers on birds. Regarding estimates of avian mortality at communication towers, former USFWS' staff member, Dr. R. C. Banks estimated mortality at 1.25 million birds killed per year at tower sites (Banks 1979). The USFWS published an estimate of nationwide human-caused annual mortality, which Banks depicted as 196 million bird deaths caused by human activity. This estimate represented 1.9 percent of the projected bird population in North America in 1979. Evans (1998) reassessed tower mortality based on increased numbers of tall towers, estimating 2 to 4 million bird deaths per year. Manville (2001b), from a December 1999 evaluation, estimated annual mortality at 4 to 5 million birds, but indicated that mortality could range as high as 40 to 50 million (2001a), based on a December 2000 assessment. Note that these are simply estimates created by extrapolation and that the uncertainty associated with these estimates is high.

The National Association of Tower Erectors (NATE) has not undertaken scientific studies. However, it indicated "not one of their members has witnessed more than a few dead birds at one time." It is not clear how these conclusions were derived as neither study design nor supporting data were presented. No information was provided on the number or type of towers. Additionally, there are a number of biases associated with detecting bird carcasses including surveyor detection, scavenger removal, habitat, and crippling biases. Without the use of a validated search protocol, mortality information is largely anecdotal and provides limited value.

Cingular Wireless and SBC Communications provided additional mortality information from a Washington State Association of Broadcasters (WSAB) survey. According to Cingular Wireless and SBC Communications, the survey members stated, "Virtually all

reported that they have never experienced significant number of bird kills at any tower site.” They also indicated that Native American tribes report few if any bird deaths at towers on their lands. Although surveys of this kind can provide anecdotal information, the absence of a more formal and technically-based approach limits the usefulness of this information.

### **3.3.2 Migration Patterns and Seasonality**

#### **3.3.2.1 *Current State of Knowledge – General***

Neotropical migrants, particularly wood warblers (Parulidae), vireos (Vireonidae), and thrushes (Turdidae) appear to be the most susceptible to collisions with communication towers. Neotropical migrants migrate between North America and Central/South America and many of these species migrate at night (Kerlinger 1995). Distribution of species recorded at tower sites will vary by season (Kemper 1996). Although mortalities of diurnal bird species’ have been recorded at tower sites, the majority of mortality records are composed of nocturnal migrants.

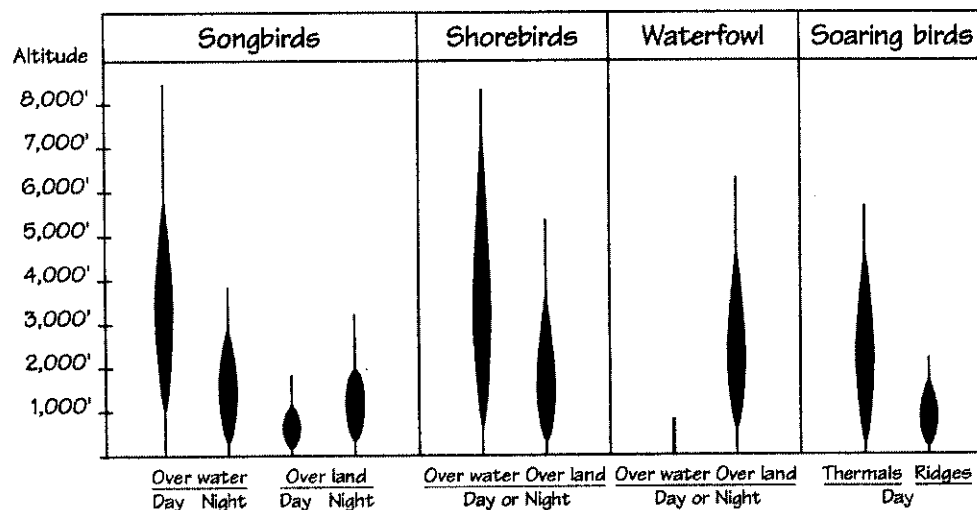
Prominent neotropical migration corridors include coastlines, mountain ridges and valleys (particularly those with a north-south orientation), and bodies of water connecting north-south land areas. Although the overall number of continent-wide birds migrating each spring and fall appears to be declining, specific population data are difficult to develop for mobile populations like birds (Temple 1998). Particularly troublesome is the collection of data for the number of birds migrating at night.

In addition, migration routes for a particular species often vary annually. Bird migration, even by the same species, does not typically occur in tight, linear patterns that traverse the same ground each year. Migration tends to occur across an expansive front and is quite complex (Evans 2000). Migrating birds exploit any number of weather-induced movements of air masses to aid their flight. These factors complicate the data compilation pertaining to avian collisions with communication structures.

Evans (2000) reported that acoustical data recorded in New York suggest that the risk of collisions for some species relative to tower siting may be the same over a large area (e.g.

within a 30-mile x 30-mile area), unless unique surface features or habitats are present. In other words, a species' risk of colliding with a communication tower would be similar within a geographical area unless unique terrain features such as coastlines, mountains, or valleys concentrate migratory movements along these features and increase the avian collision risk. Consequently, the siting of a tower in proximity to these landscape features would increase the probability of avian collisions.

The height at which birds fly is an important factor affecting collisions. Figure 3-1 depicts these altitudinal ranges by bird group and relative abundance. In migration, larger birds such as waterfowl and cranes generally fly at high altitudes. However, inclement weather and limited visibility generally force birds to fly lower, thereby correlating increased bird mortalities at communication tower sites with inclement weather, seasonal frontal movements, and reduced visibility.



**Figure 3-1 Relative Altitudes of Migrating Birds (Kerlinger 1995)**

Other forms of monitoring bird migration include the use of various radar devices. Radar ornithology has been used to study bird migration since the 1960s, but it has more recently been used to monitor individual species' movements; track the use of birds' breeding, feeding, and roosting areas; measure species' abundance and movements;

survey nocturnal burrow-nesting birds, record specific interaction and behavior of birds with overhead power lines, and determine relative impacts to birds from the operation of wind energy projects (Gauthreaux and Belser 2003). To date, one study completed in the 1980s used radar to monitor flight paths during migration near a 1,010-foot broadcasting tower (Larkin and Frase 1988). There is also a current study being conducted in Pennsylvania on three guyed, lighted communication towers ranging from 1,115 to 1,280 feet in height, using radar to monitor bird behavior and flight patterns in proximity to towers (see Section 3.4.4).

### **3.3.2.2 Discussion of Specific Studies**

#### **Biological Mechanisms**

Bird migration is a complex phenomenon that is a combination of orientational cues, such as the position of the sun, moon, and stars; the Earth's geomagnetic field; polarized light; topographical features; and continental outlines (Cochran et al. 2004, Ogden 1996). Evidence suggests that despite the multiple navigational cues available for certain bird species, individuals are likely opportunistic in the choice and implementation of these mechanisms, depending on conditions or location (Ogden 1996). Recent evidence by Cochran et al. (2004) suggests that birds may daily calibrate their magnetic compass using twilight cues at sunset before nightly migration flights.

#### **Seasonal Patterns**

The seasonal pattern for increased bird mortalities at communication tower sites shows a pronounced spike during fall migration and another smaller spike during spring migration. Brewer and Ellis (1958) and Caldwell and Wallace (1966) both reported mortality numbers 10 times greater in the fall than in the spring. This increase during the fall period is presumably due to the greater number of young birds migrating in the fall and because advancing cold fronts that often are associated with increased avian mortalities, hasten migration in the fall and actually slow migration during the spring period. Additionally, these fall weather fronts typically include low visibility, winds and overcast conditions which all appear to increase bird collision risk with towers.

One valuable summary of bird mortalities during the spring and fall migration periods was provided for the Eau Claire, Wisconsin television tower study where the number of mortalities recorded by day of the month are compiled over the 38-year monitoring period for that latitude. During the spring migration, the greatest number of avian mortalities occurs in the month of May, with a peak averaging between May 22 and 25. During fall migration, the highest numbers of mortalities occur in September, with the highest peak averaging between September 15 and 20. Large kills also were recorded during late August and early October during this long-term study; however, mortality was significantly lower than that recorded in September over the 38-year period (Kemper 1996).

Tordoff and Mengel (1956) provides a summary of the fall migration timing of adult versus immature birds by species. . This summary shows that adult and immature birds of the same species migrate at different times, with the magnitude of the difference being species-specific. Therefore, migratory movements can be complex and varied, and one cannot assume that all age groups are moving at the same time across the same plane or front.

Although Brewer and Ellis (1958) only completed 7 surveys over a 3-year period (1955-1957), their survey results suggest that bird species that migrate earlier than other species exhibit a lower mortality rate than later-migrating species. They compared species composition of mortality at a 983-foot Illinois tower to reported mass bird kills at other tower sites. Brewer and Ellis (1958) indicated that they did not know why the timing of migration affected a species' susceptibility to tower collisions. However, Crawford (1978) speculates that early migrating birds may have lower levels of mortality because they simply avoid most of the later developing storm fronts.

### **Flight Patterns**

Aggregation of birds in migration may confound mortality estimates and affect collision patterns. Aggregation of migrating birds may occur as either a line of individual birds following a feature (e.g., topography, water source) or possibly a random or evenly

distributed clumping within the group. If birds are aggregated, mortality events may occur at some towers, but not others, thereby increasing the complexity of estimating the overall volume of birds migrating during any one period (Brewer and Ellis 1958) and affecting bird distribution near tower sites. Nocturnal migrants during the fall have been observed predominantly in tight flocks, whereas spring migrants appear to be more widely dispersed (Caldwell and Wallace 1966). However, Avery et al. (1975 and 1978) and Stoddard and Norris (1967) reported relatively large spring kills; the authors speculating that the spring mortalities were typically comprised of locally breeding bird species.

### **Species Composition**

The distribution of bird carcasses on the ground near a tower site will generally depend on the individual's flight speed, height, and direction; the collision point; and wind velocity and direction. Brewer and Ellis (1958) further state that mapping carcass distribution may provide information on the relative roles of the tower versus the guy wires relative to bird mortality and possibly specifics on which species were migrating together or during the same time period.

Many researchers view avian mortality records at communication tower sites as important information pertaining to migrating birds, their distribution, and dispersal patterns. When comparing the mortality reports for the Tall Timbers Research Station tower located in northwest Florida (Crawford 1978) to those mortality records associated with a central peninsular Florida tower (Taylor and Anderson 1973), it became apparent that the two towers were "sampling" different migration patterns or systems (Crawford 1978). Other interesting migrational observations reported by Herndon (1973) included new state records of bird species' documented in Tennessee and the fact that on September 30, 1972, only 21 species (57%) of the state's 37 warbler species and no ovenbirds were recorded during the state's annual fall bird count, but that night 27 warbler species (73% of the state's warblers) and 303 ovenbirds (17% of the total kill of 1,801 avian mortalities) were reported in a mass mortality event on Holston Mountain.

Therefore, these mortality accounts provided additional insight into local migration patterns that were not apparent from the annual population surveys.

### **Summary**

A higher number of bird mortalities are recorded at communication tower sites during the spring and fall periods. The majority of these species encompass a variety of neotropical migrants, and a greater number of mortalities have been reported in the autumn. The higher fall numbers are likely due to an increased number of birds from breeding and the greater prevalence of advancing frontal systems. Difficulties in data collection and interpretation are problematic, although mortality reports have provided insight into migration patterns and species' distribution. A number of assumptions and conclusions are made, based on observations and study results; however, additional information pertaining to migratory movements, primarily of nocturnal neotropical migrants, is needed to draw additional conclusions and direct future research on this topic.

#### **3.3.2.3 NOI Questions**

The NOI did not specifically request comments on bird migration patterns and seasonality. However, these factors appear to correlate with avian collision risk at communication tower sites and a few comments on this topic were received.

#### **3.3.2.4 General Responses and Summaries**

Although there is still much unknown about how and why tower collisions occur, certain factors such as seasonal migration were mentioned by the NOI respondents. Large kills with lighted towers often are reported to be associated with songbird migration occurring in broad fronts during storm events. In the selected NOI comments and reply comments, no recent information on the effects of seasonal migration patterns on avian collisions was presented. Although respondents reference seasonal migration as a potential factor, and fall migrations may pose a greater risk than the spring migration, no specific studies or additional details were provided.

Section 3.3.2.1 discussed the relationship of bird migration in association with communication tower collisions. This summary focuses on how migration factors (e.g., seasonal patterns, bird behavior) correlate with reported tower kills and how mortality reports at tower sites aide in answering questions regarding species distribution and movement. The general consensus of respondents who discussed these issues was that additional information pertaining to migratory movements, primarily of nocturnal neotropical migrants, is needed before substantive conclusions can be derived regarding the association of seasonal migration patterns and tower collisions.

### **3.3.2.5 *Specific Respondent Comments***

Woodlot cited studies discussing the seasonality of avian mortalities recorded at communication towers stating that the majority of mortalities of neotropical migrants are reported in the spring and fall. Further, Woodlot cited data that although most mortality occurs during the fall migration the influence of varying weather conditions can affect the risk. A study was cited that indicated that cloudy nights with northerly winds appeared to result in a higher mortality rate than during other conditions.

The USFWS response referenced work by Crawford and Engstrom (2001) documenting a 29-year study where 65% of detected mortality was in the fall and 20% in the spring.

## **3.3.3 Bird Behavior**

### **3.3.3.1 *Current State of Knowledge – General***

Few in-depth behavioral studies on migratory bird behavior have been completed at communication tower sites. Avery et al. (1975) observed large flocks of blackbirds and smaller groups of sparrows, longspurs, shorebirds, ducks, and geese passing through a tower area with no difficulty. Other observations on lighted communication towers have shown a change in flight behavior and patterns as birds fly near above ground structures.

### **3.3.3.2 *Discussion of Specific Studies***

Avery et al. (1976) reported at the 1,200-foot North Dakota tower, nocturnal sightings of birds “fluttering and milling about” mainly into the wind with two observations of birds